USAWC STRATEGY RESEARCH PROJECT

THE FIFTH DIMENSION: PARALLEL THINKING AND VELOCITY SQUARED

by

Colonel Koji D. Nishimura, M.D.
United States Army
Medical Corps

James R. Downey, Ph.D.
Project Adviser

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 MAR 2007	**Strategy Research Project**	**00-00-2006 to 00-00-2007**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Fifth Dimension Parallel Thinking and Velocity Squared	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Koji Nashimura	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army War College,Carlisle Barracks,Carlisle,PA,17013-5050	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
See attached.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**		**33**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

ABSTRACT

AUTHOR: Colonel Koji D. Nishimura

TITLE: The Fifth Dimension: Parallel Thinking and Velocity Squared

FORMAT: Strategy Research Project

DATE: 20 December 2006 WORD COUNT: 7,921 PAGES: 23

KEY TERMS: Cognition, decision-making, decision theory, transformation, leadership, information technology, information operations, chaos theory, complexity theory, time

CLASSIFICATION: Unclassified

Five-dimensional parallel thinking is a higher-order cognitive skill that can be learned as a method of decision-making. This method simplifies the complex nature of decision-making and cognition. Parallel-thinking gives leaders the ability to analyze future decisions from multiple perspectives and prepare to respond to the rapid changes predicted by the advent of the information age and globalization. The concept of *velocity squared*, a means of accomplishing rapid decision-making, increases both the velocity of decision-making and of measurable effects. Velocity-squared is acquiring data quickly, converting it rapidly to usable information, quickly synthesizing information into knowledge, and then acting expeditiously to change and shape the environment to one's advantage. The action must measurably create a new direction beneficial to the decision-maker. Decision theory and cognitive theory show that higher-order thinking such as parallel thinking and velocity squared can be taught through changing the educational and Department of Defense cultures.

THE FIFTH DIMENSION: PARALLEL THINKING AND VELOCITY SQUARED

A physician sits at a computer monitor to read a Computed Tomography (CT) scan of a patient's brain. One line of information appears at a time on the screen. The image appears so slowly that the physician sits back waiting for more information to appear. Eventually, a full image of a slice of the patient's brain is displayed on the screen. The slice looks normal. Then, multiple slices appear, and a three-dimensional (3-D) image of the brain is displayed. There is a suspicious lesion in the right side of the brain. The physician controls a mouse to rotate the 3-D image and enlarge the images as needed to localize the brain tumor. After reviewing the CT scan, the physician retrieves the patient's brain scans from prior scans over the past five years. The tumor was faintly visible and 1 centimeter in size in retrospect on a CT scan six months ago, and it appears to have grown 2 centimeters since then. Finally, the physician uses a computer simulation to estimate the future growth rate of the tumor for three possible types of tumors based on its appearance on the scan. He consults a neurosurgeon who agrees that three types of tumor are possible, and they both speak with the patient to discuss further testing, the implications of each type of tumor, and the options for treatment.

The medical scenario above is analogous to the dimensions of thinking available to us. One-dimensional thinking provides us with linear bits of information that require us to remember all of the segments and then synthesize the complete picture at the end. Reading from a book or listening to a lecture is often one-dimensional. Two-dimensional thinking presents us with a cross-sectional picture of one particular plane of two variables in one specific time that may or may not contain the information we need. Microsoft™ (MS) Excel tables are examples of two-dimensional data. Driving maps are also examples of two-dimensional information that reveal alternative paths but do not show elevation which might be useful if the mode of transportation is by foot or by bicycle. Three-dimensional thinking combines multiple cross-sectional pictures to create a 3-D picture in space but gives only a snapshot of information at one particular time. Topographical maps, MS Excel surface charts, and 3-D bar graphs showing categories and series for each value are examples of 3-D data. A 3-D static model of a human heart is fascinating, but a moving time-varying 3-D, or four-dimensional, model of the beating heart shows much better how the heart functions. Four-dimensional thinking provides us with the 3-D picture as it changes over time much like the model of the beating heart with forward and backward controls. The fifth dimension is added by considering multiple 4-D scenarios simultaneously. Five-dimensional thinking provides us with plausible parallel pictures of the future. Using the same beating heart model, as shown in figure 1 below, we could show the

deleterious effects of smoking, poor diet, and heredity on coronary artery disease over time as well as the beneficial effects of exercise or medication. This model is capable of showing the effects of two or more variables on parallel outcomes over time. More importantly, this model can be used to compare multiple scenarios of unrelated variables over time.

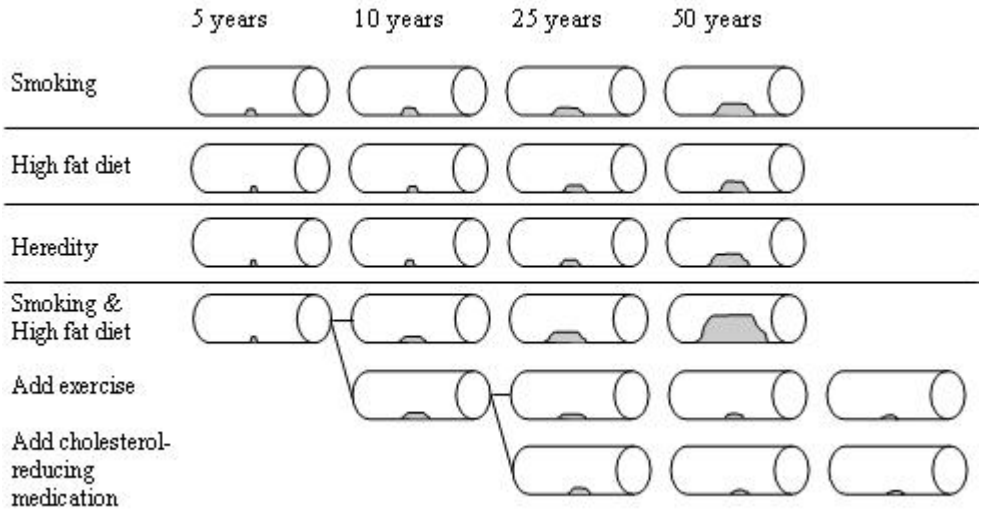

Figure 1. Effect of smoking, diet, heredity, exercise, and medication on coronary arteries.

In this paper, I introduce the concept of *five-dimensional parallel thinking*, a higher-order cognitive skill that can be learned, as a method of decision-making. Next, I present the concept of *velocity squared*, a means of approaching decision-making that increases both the velocity of decision-making and of measurable effects. Third, I discuss the types of cognitive theories and their implications on decision validity. Finally, I offer my recommendation on how to teach these higher-level decision-making skills.

First, I first propose that teaching *five-dimensional parallel thinking* to future leaders will enhance their ability to be mentally agile leaders. Parallel thinking is a systematic way to think flexibly, anticipate changing situations, and rapidly enact plans based on multiple assessments. Parallel thinking expands the linear thinking that is ingrained in us through education from childhood.[1] In addition to a new way of thinking, I present the means by which to teach a future generation of leaders how to think creatively through parallel thinking.

I will discuss the numerous implications of parallel thinking. Thinking about the future as a number of parallel possibilities is a superior way of thinking, planning, and doing. By thinking about parallel possibilities, the mentally agile leader may plan to implement tests to actively differentiate among the possibilities. The leader may monitor for signs and symptoms that indicate how the actual course of events is transpiring, and best of all, he may review the

implications of several possibilities well ahead of time. By proactively developing the best courses of action for each possibility, the leader is ready to respond rapidly to several scenarios. Thinking in parallel is thinking about and preparing for multiple scenarios over time.

Second, I propose the concept of *velocity squared* as the means to accomplish parallel thinking. Velocity may be described as the rate of processing data into information then knowledge. Velocity squared describes the process of observing an environment, extracting raw data, converting the data into useful information, synthesizing the information into actionable knowledge, and most importantly taking rapid action to change the initial environment. The emphasis is on shaping the initial environment through actions that have measurable effects.

Velocity squared as a concept is new, but I present the use of these principles by Army leaders. The concept is supported by research in the field of decision theory and has implications both for lower-echelon leaders making complex decisions and for higher-echelon senior leaders making decisions using extensive situational data provided by technological advances.

Third, I show that higher-level thinking can be taught. The method of teaching higher-level thinking that will be transferable and lasting is presented as five recommendations. These recommendations should provide leaders with the skills necessary to manage the Volatile, Uncertain, Complex, and Ambiguous (VUCA) environment created by the information age and globalization.

In the following sections, I describe in detail all of these concepts and applications of parallel thinking and velocity squared in the context of leadership, decision-making, and education. I conclude with recommendations for implementing this system of thinking in the Department of Defense.

What is Parallel Thinking?

I conceived of the model of parallel thinking as an outgrowth of developments in physics. With the recent advent of superstring theory that attempts to explain nature, physicists created the concept of parallel universes to help explain many of the irregularities of the world.[2] For instance, physicists have pondered why it is that the force of gravity of the entire earth is so weak that a small magnet can overcome it and pick up a metal object. Why are the forces called gluons that hold together some subatomic particles stronger as they get farther apart? Superstring theory provided a better theory that explained these irregularities and tied together gravity, electromagnetic, and nuclear forces. When the concept of higher dimensions was

added, reality became simpler for physicists to understand and explain. The fifth dimension and parallel universes are an outgrowth of this superstring theory. Table 1 and Figure 2 provide a summary of the characteristics and examples of the first through the fifth dimensions.

DIMENSIONS	CHARACTERISTICS	EXAMPLE
1	Length	Line
2	Length and Width	Flat map
3	Length, Width and Height	3-D model
4	Length, Width, Height and Time	Moving 3-D model
5	Parallel universes	Simultaneous scenarios involving the same actors

Table 1. 5 dimensions: Characteristics and examples.

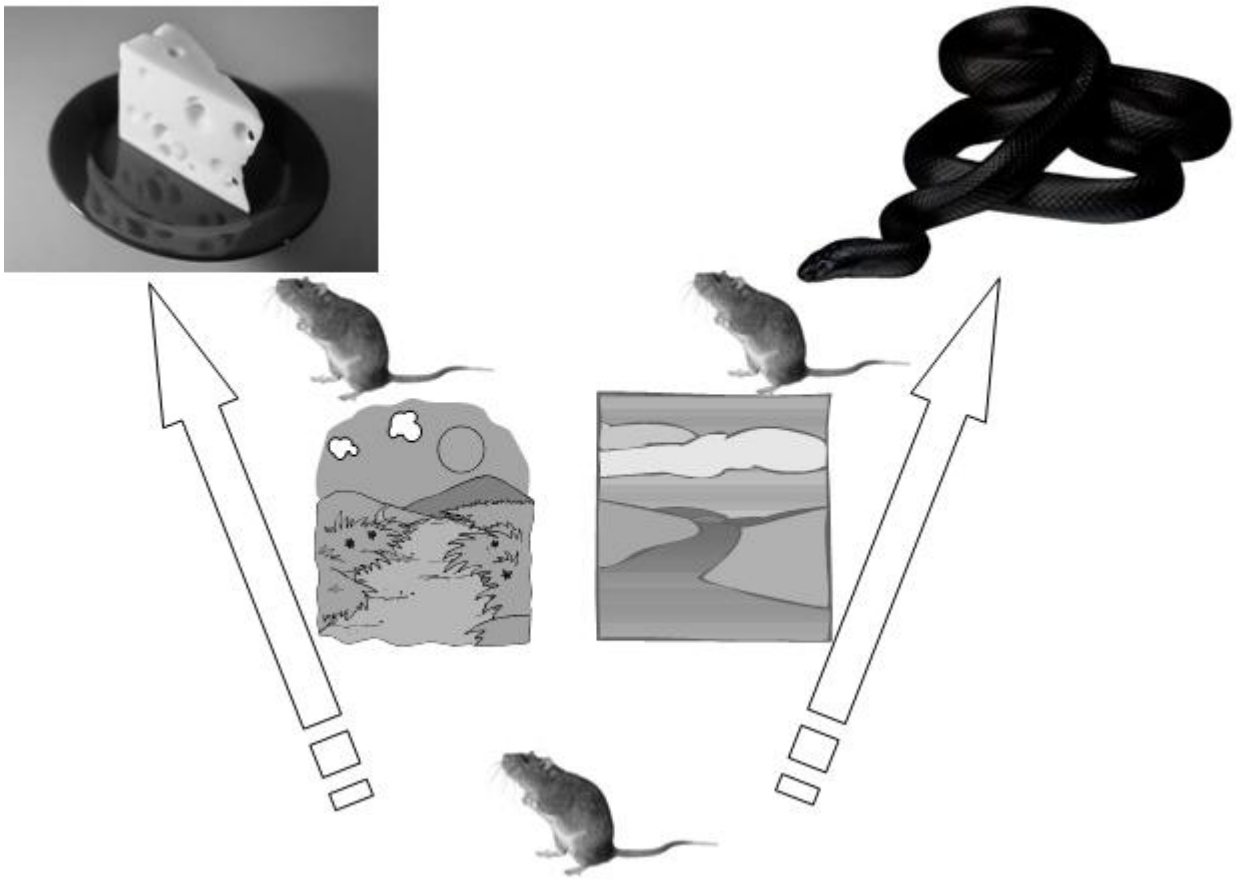

Figure 2. Parallel Universes: Being able to see plausible futures simultaneously.

In the modern scientific era, even lay persons understand the concept of the four dimensions and length, area, volume, and time. The first three dimensions of length, width, and

height when combined together form a concept called space. In the superstring theory, ten or eleven dimensions exist, and the fifth and higher dimensions are subatomic in size. So although scientists have not proven the superstring theory, physicists are working on experiments to prove that parallel universes and the fifth dimension exist, and thus the concept of the fifth dimension is based on science.[3]

In the fifth dimension, parallel universes may be likened to a stack of Digital Versatile Discs (DVDs) as in figure 3, each a world in itself. For instance, DVDs might each store a comedy movie, action film, dramatic play, musical, and a cartoon. The entire stack of DVDs is the true sum of reality, but we can see only one DVD universe at a time when constrained to four dimensions. Parallel thinking is similar to watching several DVDs or television channels simultaneously, scanning for a program of interest to us, and choosing a program to watch.[4]

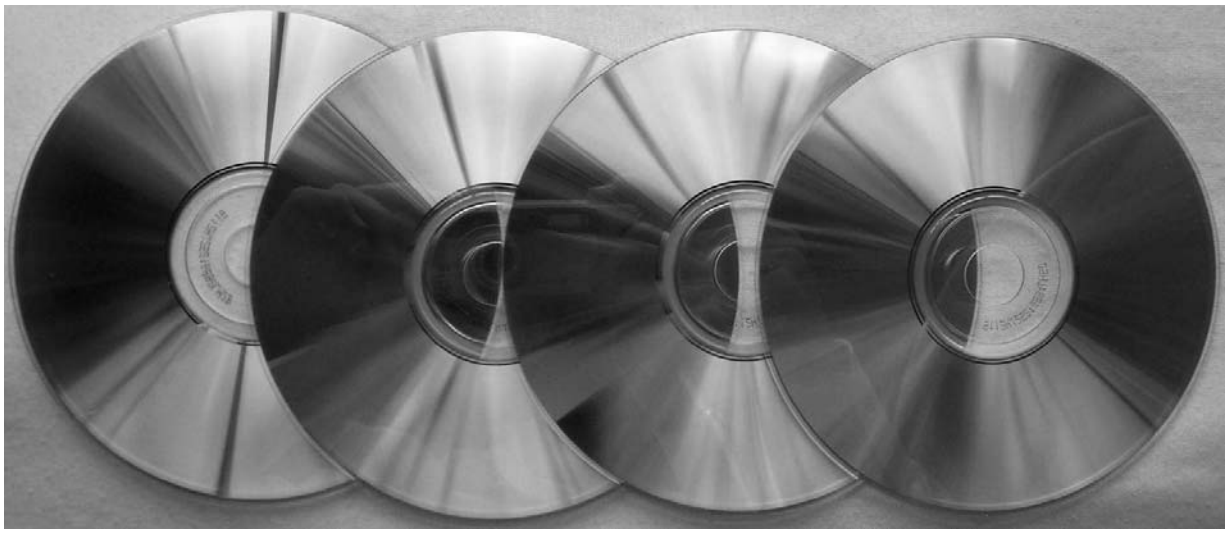

Figure 3. Digital versatile disks (DVDs) as an analogy of parallel plausibilities.

Five dimensional parallel thinking is higher-level thinking that simplifies the complex nature of decision-making and cognition. By breaking up complex problems and thinking beyond four dimensions into parallel dimensions, leaders gain the ability to analyze future decisions as possible courses of action. As figure 2 illustrates on the previous page, being able to see plausible futures may help decision-makers to decide on the optimal course of action.

Thinking through choices using parallel thinking provides the leader with flexible options, plausible alternatives, and advance planning. Even if the plausible courses of events do not transpire exactly as expected, the process of having thought through options may still provide

the decision-maker with information that will help him to decide more quickly the best course of action.

Parallel thinking will be the way of thinking for the upcoming generation of multitasking, attention-partitioning, and cognitively complex young thinkers.[5] Parallel thinking is a form of higher-level thinking. Leaders can be taught to use parallel thinking through the process of developing mental agility.

Developing Mentally Agile Leaders

Mental agility is defined in the final draft of Field Manual 6-22 on Army Leadership by the following qualities:[6]

1. Breaking out of mental sets or habitual thought patterns;
2. Rapid application of multiple perspectives and approaches to assessment, conceptualization and evaluation;
3. Anticipation of or adaptation to uncertain or changing situations;
4. Flexibility of mind;
5. Thinking through second and third order effects when current decisions or actions are not producing the desired effects;
6. Improvisation when faced with conceptual impasses.

The first quality of mental agility is *breaking out of mental sets or habitual thought patterns*. Parallel thinking is a natural outgrowth of the higher-order thinking inherent in mental agility: Parallel thinking extends the qualities of mentally agile leaders. How does parallel thinking enhance the qualities listed above? First, it does so by creating new mental processes and thought patterns. Thinking in five dimensions is the next step in a progression from ingrained habitual thought patterns and mental processes we learn when we are young to a more advanced way of thinking that requires physical and intellectual maturity. In the physical realm, studies of primate and human cognition and development show that children develop concepts about space first through their senses and actions, then progress through topological or two-dimensional thinking, then through projective or more concrete three-dimensional thinking, and finally through Euclidian or more abstract thinking such as thinking in time or parallel thinking.[7] Further, the progression differs in ontology versus phylogeny; that is, intellectual development and thinking in more advanced ways can be taught and is separate from genetic and developmental influences of nature.[8]

In the intellectual realm, Bloom's Taxonomy is a stratification model of levels of thinking that is applicable to the process of parallel thinking. Although initially designed for college and university examiners, the Bloom's mental thinking model and its progressively intellectually mature levels of Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation and their subgroups have become popular among educators in teaching higher-order thinking.[9] Parallel thinking requires the use all of these cognitive levels, and teaching these skills may be helpful in developing higher-order thinking.

Higher-order thinking and parallel thinking is not constrained to academic theory for it has very practical uses as well. The following practical example using parallel thinking in the context of military scenarios shows how parallel thinking might change military outcomes. In Operation Anaconda in Afghanistan, military planners developed a plan of attack on a Taliban and al-Qaeda stronghold based on an assumption that the enemy would choose to escape through the mountains. Rather than plan for multiple plausible courses of action by the enemy, planners developed a single offensive plan to attack from the left and right flanks then trap the escaping enemy from behind because, up to this point in time, the Taliban had always run away when attacked. When the Taliban and al-Qaeda fighters unexpectedly fought back from well-protected and well-supplied fortifications, U.S. and friendly Afghan Soldiers found themselves outgunned, surrounded, and on the defensive instead of the offensive.[10] If planners had used parallel thinking to analyze several plausible reactions of the Taliban, even though the Taliban was most likely going to run away again, this scenario might have been anticipated.

If a leader faces a situation in which he must decide how to attack an enemy stronghold, the leader and his planners go through a thinking process of collecting data about the environment, gaining knowledge from the data, understanding the implications of the knowledge, and then acting on this knowledge. They must have intelligence or knowledge about the enemy such as numbers of fighters, armaments, fortifications, and reinforcements. This knowledge of the enemy must be comprehended and analyzed for its importance, benefits, and risks. Based on the analysis, the leader synthesizes tactical experience and theory, and applies the strengths of his people and their equipment along with supporting elements to devise a plan. In the normal two-dimensional thinking model, options are quickly reviewed, and full planning commences for the one best option such as happened in Operation Anaconda. Because historical evidence strongly suggested that the enemy would flee, this course of action was the only option fully developed. The other plausible options were not analyzed as well. If the one best option begins to go awry, subordinate leaders must improvise quickly, and

hopefully they will choose wisely. Fortunately in Afghanistan, combat leaders and pilots performed acts of heroic proportions to overcome the potentially disastrous circumstances.

Alternatively, using five-dimensional parallel thinking, planners would consider several options, analyze each option, and develop them sufficiently such that they could be accomplished if necessary. In case the original best option begins to fail, other options are immediately available. Plans to commit greater resources, utilize more powerful weapons, or employ greater numbers of aircraft to support ground troops would already be in place. Leaders would analyze alternative tactical strategies that would allow them to decide and act rapidly.

Parallel thinking is helpful in operational settings such as the combat example above, and it is also useful in strategic large-scale contexts. When I asked an Arab U.S. Army War College student if American officers had an accurate view of the Arab world, his reply was simply, "You must read more." He went on to explain that Americans need to read English versions of the many Arabic newspapers and online websites that would give an insight into the mind and perspective of the Arabic people.[11]

Using parallel thinking, we should read about a world event in many news sources from multiple regions around the world. Intelligence gathering and cultural understanding of a people of interest would include monitoring many parallel international sources. This parallel view of a single world event from many different perspectives and cultures provides a more complete way to determine its significance.

The idea of parallel thinking not only includes interpretation of past facts, but it also extends to future decision-making and the interpretation of the actions and messages of foreign allies and enemies. Parallel thinking would encourage planners to understand and anticipate an opponent's actions and decisions from the opponent's cultural, religious, and political perspectives. For instance, studies show that there are significant differences in thinking and world view between Asian (Chinese, Japanese, and Korean) and Western (American, European, British) people.[12] Table 2 on the next page compares and contrasts thinking characteristics between Western societies and Asian societies. We often assume that because people around the world are members of the same biological species, they share the same thought processes and behaviors. The reasoning goes that because people share similar biological make ups, they function the same. Much as we would erroneously assume that if two computers are built the same, they would function the same, we know that software programming changes the practical functioning of computers immensely. People who are programmed differently may also function differently.

THOUGHT	WESTERN	ASIAN
Behavior of physical objects, animals, humans	Straightforward rules (logic), categorization	Complex interactions (many factors), contextual
Human cognition	Same worldwide	Not the same
Sense of self	Individual, independent	Collective, interdependent
Events	Rules knowable, can control events	Highly complex, multifactorial influences
Admirable character	Strong, forceful, powerful, quick	Quiet, humility, calm, slow
Infant knowledge	Learn nouns faster	Learn verbs faster
Facts	Accept logic as the deciding factor	Accept contradiction
Behavior	Judge behavior at face value	Judge behavior in context of situation, tend to hindsight bias
Relationship among events	Seen less well	Seen more easily, difficult to separate individual events from others

Table 2. Differences between Western and Asian thinking.[13]

Critical thinking, the definition of which is debatable in academic circles, is another popular method to encourage the higher levels of thinking. For this paper, critical thinking is the U.S. Army War College system of critical thinking.[14] The steps under this model are the following: 1) Clarify Concern, or determine the real issue and its complexities; 2) Use Multiple Points of View; 3) Understand Assumptions; 4) Consider Inferences, and make sound evidence-based conclusions; 5) Evaluate Information, or validate sources for logic, bias, and errors; and 6) Comprehend Implications including short-term and long-term effects on stakeholders, second and third order effects, thinking through the possibility of false assumptions or misleading variables, and creative options. Also for this paper, higher-level thinking includes processes such as interpretation, synthesis, application, illustration, inference, comparison and contrast, distinction of the central from the peripheral, and prediction.[15] The use of all of critical thinking and higher-level cognitive functions is essential to the development of parallel thinking. Since parallel thinking requires the review of information and courses of action in multiple dimensions, leaders must use mental discipline. Tools such as critical thinking and higher-level thinking should be taught to leaders and practiced in order to facilitate multi-dimensional planning processes.

The second quality of mental agility is *rapid application of multiple perspectives and approaches to assessment, conceptualization and evaluation*. Parallel thinking creates a system of rapid application using multiple perspectives and approaches. By definition, the parallel thinking process is one of establishing multiple plausible courses of events from many perspectives. Using higher-level cognitive skills, the leader develops each course sufficiently to allow for rapid decision and action. In the example of forces entering an enemy city, leaders who have considered fully the alternate courses of action will have these alternatives ready at hand for rapid implementation. More importantly though, the leader will have established a system of thinking through the mission that will provide a basis for thinking about the situation even if the scenario unfolds differently from all considered alternatives.

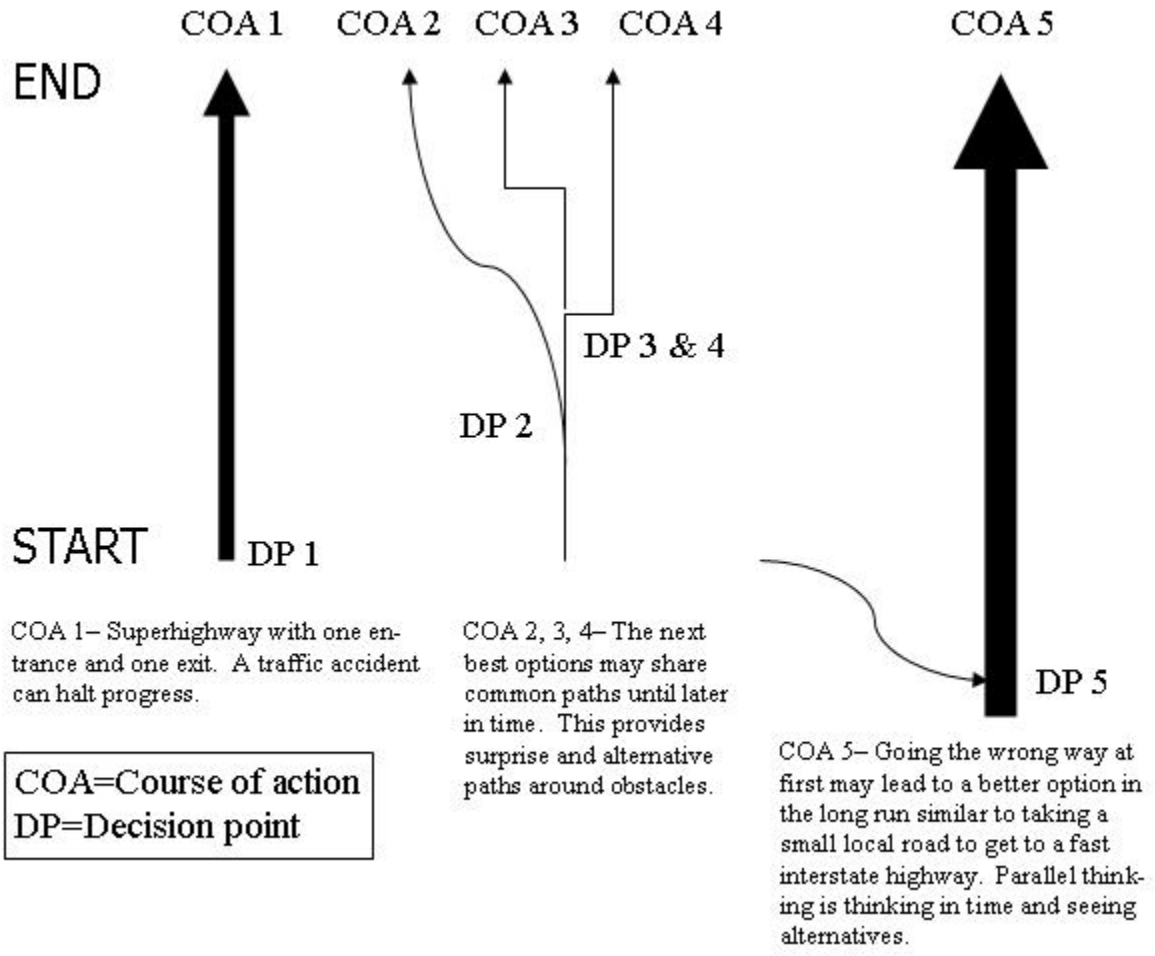

Figure 4. Using parallel thinking to think through courses of action.

Figure 4 on the previous page illustrates the use of parallel thinking to evaluate options. The thickness of the arrows represent speed: The thicker arrows are faster. Course of action one (COA1) seems to be the best option because it is the most direct. Once started along COA1, there is no other option available. This option is like a super highway with no exits. If a traffic accident blocks the road, the only option is to stop and wait. The decision point (DP1) for this course of action lies at the very beginning. A second-best option with multiple exits and alternate courses of action may actually be the better option. Thinking in the dimension of time, if the initial road in the second-best option coincide exactly with those of third-best and fourth-best options, this course of action (COA2) may provide the leader with the flexibility to choose other courses of action (COA3 or COA4). The decision point committing him to course of action 2 occurs later in time (DP2). If the final destination for COA2, COA3, and COA4 are very close, the leader may approach the goal from any of these courses of action that are indistinguishable until later in the course of events. If COA2 is blocked, he may change to COA3 or COA4 before he reaches the decision point. Course of action 5 (COA5) shows that the most direct route may not be the quickest. By going in a different direction along an indirect route, one could reach the destination more quickly.

In an example of using an indirect route such as course of action 5, anti-satellite warfare to destroy a satellite uses thinking in time. The quickest way for a missile to reach a target satellite may not be to fire the missile as early as possible. Instead, if the satellite travels toward the missile launch site more quickly than the missile can fly, waiting to launch the missile by several minutes may destroy the satellite in less time. By making launch time variable in the calculations, scientists have found that the satellite's orbital movement and the earth's rotational movement would bring the satellite closer to the missile than the missile velocity alone could accomplish.[16] Parallel thinking and higher-order thinking provide the leader with the ability to rapidly decide and change strategies, and they provide the leader with options to consider alternate courses of action that are more flexible and powerful.

The third quality of mental agility is *anticipation of or adaptation to uncertain or changing situations*. Parallel thinking allows a decision-maker to anticipate and adapt to uncertain conditions. From the business literature, there are four types of uncertainty: 1) Variation, in which *factors* that influence outcome vary but within a *predictable* range; 2) Foreseen Uncertainty, in which a few known *factors* may influence the outcome in *unpredictable* ways; 3) Unforeseen Uncertainty, in which the *factors* that will influence the outcome *cannot be predicted*; and 4) Chaos, in which *unpredictable or unknown factors* or events invalidate long-

term targets, plans, or action plans.[17] Table 3 on the following page lists these types of uncertainty.

UNCERTAINTY	FACTORS	OUTCOMES	MITIGATION
Variation	Known	Predictable range	Business models
Foreseen uncertainty	Known	Unpredictable	Attention to factors
Unforeseen uncertainty	Unpredictable	Unpredictable	Attention to outcomes
Chaos	Unpredictable or unknown	Unpredictable	Long-term targets, plans, actions invalid

Table 3. Types of Uncertainty, Factors, Mitigation Actions.

Variation, the first type of uncertainty, can be easily managed through business tools such as Six Sigma or Lean Six Sigma; and Foreseen Uncertainty, the second type of uncertainty, can be managed through focused attention on the known factors. Parallel thinking may be used in both of these situations, but the strength of parallel thinking lies in its application to situations of the last two types of uncertainty, Unforeseen Uncertainty and Chaos.[18] In Unforeseen Uncertainty settings, active monitoring for and detection of unpredictable factors must be accomplished, and alternate actions must be created. By using parallel thinking, alternate actions are planned in advance. In Chaos settings, multiple parallel courses may be developed for at least the most plausible factors, and the ability to quickly detect and act upon changing situations is possible. Although a leader cannot plan ahead fully for chaos, a leader can use knowledge of chaos theory to his advantage.

Complexity theory, of which chaos theory is a part, is a larger theoretical construct to study non-linear, dynamic systems.[19, 20] Briefly, chaos theory states that if seemingly random events are in fact just very complex events, we may narrow the range of plausible future events and almost rule out the possibility of other events. Chaos theory narrows the focus of future plausible outcomes whereas predictions prognosticate one or at most a few most likely outcomes. Therein lays the beauty of parallel thinking: Because we cannot reliably predict the future with precision, parallel thinking allows a leader to plan for plausible futures predicted by complexity and chaos theories. The leader anticipates the expected factors or expects the unexpected factors and then adjusts to the situation.

The fourth quality of mental agility is *flexibility of mind*. Parallel thinking encourages flexibility of mind and improvisation. Flexibility and improvisation are closely related to creative thinking. In the creative thinking literature, memory recall is described as a cascade of activation spread in the brain in which a topic and its group of related thoughts lead to other related topics and groups of related thoughts.[21] This expanding web-like system of cognitive processes leads to the development of creative ideas and the adaptation of related ideas and

improvisation. In parallel thinking, the process of thinking through various alternatives creates and renews these webs of related memories. In the heat of action, the leader may use these memory webs to quickly develop ideas and solutions. In figure 5 below, webs of related thought come to mind when a decision is made. If this thinking process is performed ahead of time, these webs of thought are refreshed in the memory and come more quickly to mind when needed.

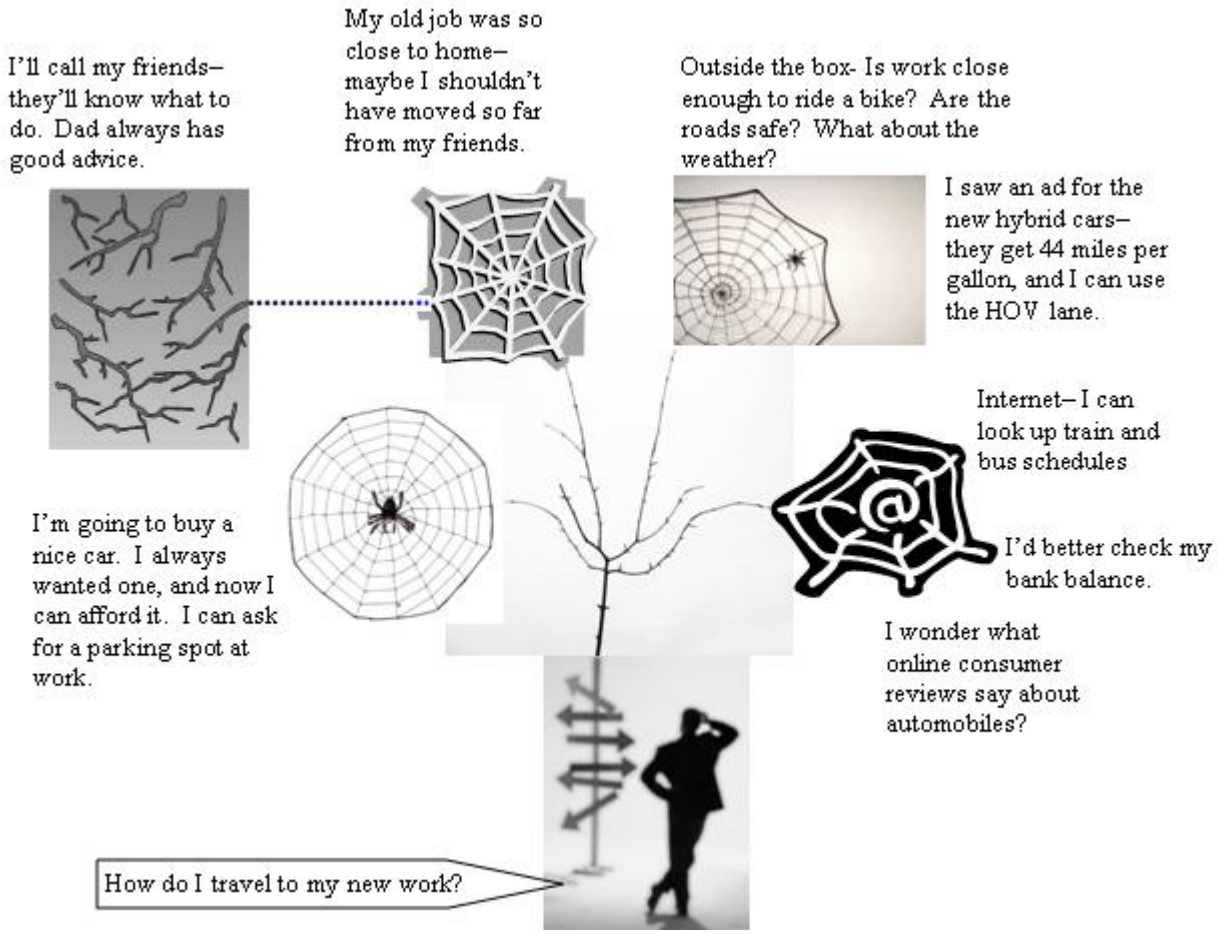

Figure 5. Webs of Related Thought.

Additionally, the literature shows that expert recollection of facts inhibits creative thought.[22] For example, if we know the meaning of a word with surety, we often do not spend time coming up with varied meanings that are less accurate. Unless we are actively engaged in creative thinking, we stop our thinking process once we have found a reasonable conclusion. Put in another way, if we cannot think of a better solution, and the solution at hand is sufficient, we tend to stop looking for alternative solutions. Parallel thinking forces a leader to continue to explore alternative situations and options that stimulate creative thinking.

The fifth quality of mental agility is *thinking through second and third order effects when current decisions or actions are not producing the desired effects*. Parallel thinking is a system that considers second-order and third-order effects in the cognitive process. As an example of three-dimensional thinking in the Israeli-Hezbollah conflict of 2006, the Israeli Defense Force had to consider air, land, sea, and space operations. Thinking further in three dimensions, they would consider depth as well as height: In fact, Hezbollah used underground tunnels to enter Israel and kidnap Corporal Gilad Shalit on June 25th. Israeli troops had not anticipated the extensive nature of Hezbollah's underground bunker systems in southern Lebanon which required significant military firepower to defeat.[23] The use of these indirect fires with its collateral damage contributed to negative worldwide publicity. In addition, the Israeli Defense Force (IDF) failed to utilize its war plans for Lebanon that were based on sound principles of war and instead attacked isolated targets with fire and assault. Both the Lebanese and Israeli governments made false assumptions that led to a war with far-reaching second- and third-order effects. The Lebanese government assumed that Israel would use limited retaliation and would eventually trade the captured Soldier for many Lebanese prisoners. The Israeli government assumed that the IDF would defeat the Lebanese Hezbollah organization in a few days and rescue the kidnapped Solder. Lebanon's thinking resulted in devastation of southern Lebanon, and Israel's thinking led to a strategic defeat that forced top military officers to resign. Parallel thinking would have analyzed the scenarios that unfolded as part of parallel plausible outcomes, and the risks might have been anticipated ahead of time.

Similar three-dimensional thinking about tunnels is required in Korea where tunnels were found to extend well into South Korea. Even in mature and established theaters of operation, parallel thinking can provide leaders with new insight to plan for possible scenarios that may lead to strategic victory or defeat. With the advent of North Korean nuclear weapons development, strategic planners and leaders need to engage in five-dimensional analysis and develop fully planned and practiced responses to the multiple scenarios that may not be fully predictable.

Parallel thinking adds four-dimensional thinking by thinking in time. Fighting in four dimensions is already being used by Iraqi insurgents as they take aggressive action by placing Improvised Explosive Devices (IEDs) and then activating them later in time. The aggressive action is accomplished in one time frame, and the effect of the violence is consummated in another time frame. To counter the insurgents' use of time, we could develop devices that call all cellular telephones in an area and that would detonate IEDs prematurely. This countermeasure uses time to our advantage. Using a jamming device would provide a

countermeasure that works only in the limited time frame required for the safe passage of friendly troops.

Insurgents also use time. They not only act quickly to obtain effects before we may respond, but they also act persistently over a long time in order to attain goals beyond the limits of our acceptable and short timelines. By extending the fight into a prolonged war, the insurgents use time as a leverage to decrease the will of the U.S. population to continue the fight. Following the imposition of timelines for withdrawal, insurgents simply wait quietly until Western forces depart.

In five dimensions, parallel thinking develops related parallel alternatives. Sophisticated use of parallel thinking permits us to think about the interaction of the parallel courses of events and actions. Parallel thinking even requires the possibility that more than one course of events may occur simultaneously or closely in time. Thinking through the relationships of the parallel courses of events allows the leader to consider how one course of action may affect the others. The core of recognizing second-order and third-order effects is recognizing interactions.

Summary of Parallel Thinking

In the first section, the concept of five-dimensional thinking or parallel thinking was presented. For the mentally-agile leader of the future, three-dimensional thinking would also include inner space as well as outer space in areas such as nanotechnology, biotechnology, and gene technology. Four-dimensional thinking would include effects in time. Ultimately, five-dimensional thinking would give future leaders the advantage of thinking in parallel situations to take rapid and decisive action.

In today's environment sometimes described as one of Volatility, Uncertainty, Complexity, and Ambivalence (VUCA) in which the terrain ahead is unclear and changing, parallel thinking offers the advantages of a broad view and maneuverability. When walking in the dark, it is better to use a flashlight than a laser pointer. In a world in which the velocity of information is increasing exponentially,[24] leaders must be able to think in multiple dimensions over time in order to rapidly respond to changing and uncertain situations. Leaders must think creatively and effectively to monitor the global environment for signals indicating which plausible future courses are transpiring. Leaders must then act to change the environment early at the trunk of events before branches begin to diverge. Also, there must be a shift in emphasis from a system of exclusively long-range strategic planning to a system that includes short-range crisis action planning with short-term planning horizons used by the U.S. Marine Corps and the Special Operations Forces.[25]

Tomorrow's leaders must be able to see the past and develop ways to establish plausible parallel future situations. They must extend their thinking and planning beyond the achievement of the objective. Only by planning for these multiple future situations will leaders be able to act rapidly upon the signals that indicate which of the parallel situations is transpiring. Parallel thinking takes more time, so the question arises: How does a leader find time to use parallel thinking? The answer is found in the concept that I call *velocity squared.*

Velocity Squared

Velocity squared is more than just velocity. *Velocity* in decision-making is sensing an environment, acquiring data about the environment quickly, converting it rapidly to information, and then quickly synthesizing information into *knowledge*. *Velocity squared* is sensing the environment, acquiring data quickly, converting it rapidly to usable information, quickly synthesizing information into knowledge, and then acting expeditiously to *change and shape the initial environment to one's advantage*. Knowledge without action is inadequate: Action by itself is insufficient. Knowledge must be followed by action that measurably alters the initial environment in a way that is beneficial to the decision-maker. So, velocity squared within an environment is the rapid collection of data, interpretation, synthesis, and action to shape one's environment in a measurably positive way.

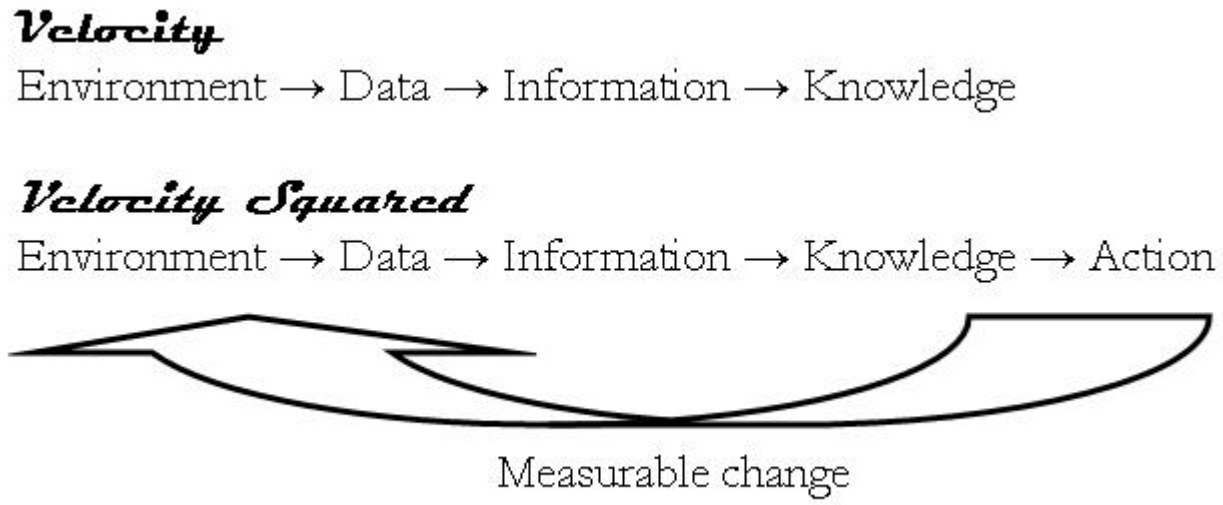

Figure 6. Velocity versus Velocity Squared.

Rauno Kuusisto of the Finnish Defense Forces Finland described the definitions of data, information, and knowledge in one of several thesis papers for his Ph.D. in Proceedings of the

4th Australian Information Warfare and Security Conference in November 2003.[26] He proposed that *data* is facts represented in a formal manner; *information* is the understanding of relations and has meaning, purpose, and relevance; and *knowledge* is the ability to turn information and data into effective action. What is missing in Kuusisto's concept is the measurable effect of the action. By measuring the effects of an action, we create a process called effects-based action.

General Tommy Franks wrote of velocity in Operation Iraqi Freedom (OIF) in his autobiographical book *American Soldier*. "I see this campaign in four dimensions, with time—unprecedented speed of operation—being a major factor."[27] "Just as in physics, though, the effects of mass increased with velocity… The size of our attack force was less important than the speed and flexibility of its maneuver."[28] General Franks appreciated both the need for velocity and the ultimate effect upon the enemy.

Knowledge is also referred to as situational awareness in combat operations. In a presentation at the U.S. Army War College, Professor Dennis Murphy presented a key finding of the V Corps battle in OIF that situational awareness led to risk-taking behavior manifested through boldness and audacity in which a commander "could assume a risk, discover he'd made a mistake and correct it before the enemy realized he'd taken the initial action."[29] The importance of the effect upon the enemy is also stressed in this study.

Colonel Richard Hooker, Commander of the XVIII Airborne Corps Combat Support Brigade; Colonel H.R. McMaster, Commander of the 3rd Cavalry Regiment; and Colonel Dave Gray, Commander of the 101st Airborne Division (Air Assault) stressed the importance of situational awareness and parallel options in their article on Army transformation. Situational awareness or information superiority, "…translate into faster decision cycles, forestalls enemy reactions, creates more friendly options, and minimizes risk."[30] The authors stressed the importance of this type of knowledge and velocity on decision cycle timing, enemy actions, friendly options, and operational risk.

In Operation Iraqi Freedom, insurgents began using improvised explosive devices (IEDs) as a weapon. The U.S. response to place armor plating on unarmored vehicles was slow. Velocity squared thinking in this situation would have called for rapid decision-making and timely results to respond rapidly to this emerging threat and save the lives of American Soldiers.

Velocity squared may be used in other settings: Diplomatic negotiations require analysis and action to improve one's standing; business organizations constantly look for the data, information, knowledge and actions that will provide a competitive edge; medical teams carefully monitor patients for vital signs and laboratory parameters to correct bodily malfunction; decision-makers make choices based on relevant data, information, knowledge, and experience within

time limits; and athletes subconsciously use this process to sense their surroundings and other players, consider options, and react at the right time and in the right ways that give them the best chance for success.

In the setting of parallel thinking, velocity squared is the key to rapid and optimal decision-making. Decision-makers may not make optimal choices in a high-velocity environment faced with multiple choices when factors and consequences are uncertain, ambiguous, or unknown. Through education and training in decision theory, strategic leaders can understand how the uncertainty of data, framing of the problem, risk aversion, personality, mood, and team interaction affect decisions. Being taught to be aware of factors that influence decisions, leaders may then use a system such as velocity squared to help them in making optimal decisions under such stressful conditions.

A leader in the real world may be taught to see the situations in which his decisions and actions may make a difference and practice making timely responses in such situations. Just as in a role-playing video game, the timing and appropriateness of input may change the scenario or outcome. Velocity squared will become more important as technology automatically changes information into knowledge. Robert Garigue describes how the current Transmission Control Protocol and Internet Protocol (TCP/IP) used for addressing and verifying data transmission will improve by attaching information directly to the data through the use of Extensible Markup Language (XML) or similar technological advancements.[31] As information becomes immediately usable, transmission bandwidth increases, computer processors become faster, and artificial intelligence programmers develop better programs, the velocity of decision-making will increase.

In this section, I presented velocity squared as a possible way to accomplish parallel thinking processes more quickly and effectively. In the next section, I discuss how parallel thinking using velocity squared can lead to better decision-making. I begin with a discussion of decision-making theory as the scientific basis for understanding how humans make decisions. I then present the classification of choices based on whether outcomes and probabilities are known. Finally, I outline the environmental and personal factors that influence decisions.

Parallel Thinking, Velocity Squared, and Decision-Making

Tests of suitability, acceptability, and feasibility may be used to measure the validity of a concept.[32] Velocity-squared and parallel thinking decision-making principles are *suitable* to achieve ends and are *acceptable* to several prominent Army leaders. One must ask the question of *feasibility* and whether leaders, and humans in general, are capable of making

better decisions when forced to think about multiple options under time constraints. Theory is academically stimulating, but real-world application of theory requires consideration of both scientific rigor and human behavior. The field of decision-making theory provides insight into the answer to this fundamental question of feasibility.

The answer to this question is strategically important. As our military forces move decision-making down to lower-level leaders to increase the velocity of command in our dispersed and independent military units, can we predict how our young junior leaders will respond to this challenge? As operational and strategic leaders see the battlefield more clearly than in the time of Napoleon and Sun Tzu, will senior leaders be capable of managing the many options and velocity? In other words, do humans possess the means to rapidly make complex decisions with multiple choices? Decision-making theory provides evidence to answer this question as well.

Decision-making theory is not just one theory, but it is a field of many theories. Wayne Lee describes the various theories in his book, Decision Theory and Human Behavior.[33] All of these theories contain assumptions and inferences of human decision-making behavior that must be considered when interpreting the results of studies about decision-making and cognition.

Robyn LeBoeuf and Eldar Shafir brilliantly summarize some of the major findings of scientists in the field of decision-making.[34] LeBoeuf and Sharif present evidence suggesting that people can and do make complex decisions, people do not make complex decisions consistently, and decisions are affected by many factors of the environment and personal condition. We should also address how age affects decision-making, and whether people can make rapid decisions.

Regarding time, C.R. Gallistel and Rochel Gelman show that even pigeons can make decisions that require time calculations.[35] In studies of people, tests of reasoning show that speeds of studying problems, reading, and reasoning slow with age. The cause of the slowing is not due to a difference in the strategy of test-taking but appears to be a slowing in input and output velocity, mentation, and a decrease in short-term recall or working memory that facilitates multi-tasking. Not only is speed decreased with aging, but decision accuracy also decreases with age. These decrements begin between the ages of 40-50 years.[36] These findings provide evidence for pushing leadership decisions requiring complex and multiple options to younger leaders. Further studies are needed to determine the importance of knowledge and experience on complex cognition skills.

The studies on decision-making theory above show that it is indeed feasible for leaders to learn how to use parallel thinking and velocity squared. In the next section, I discuss my recommendations on how to educate current and future leaders in higher-level thinking such as parallel thinking and velocity squared, and I propose that higher-level thinking is best taught at earlier ages than at the senior leadership level. First, I briefly present models of cognition that form the basis of teaching higher-level thinking, and then I proceed to the benefits and challenges of teaching higher-level thinking.

Educating Leaders

Educating leaders requires thoughtful applications of a systematic model of cognition if the goal is teaching higher level thinking. Brent Davis and Dennis Sumara in the Harvard Educational Review propose an *enactivist model* of cognition that is based on complexity theory, ecology, and hermeneutics, blending the roles of teacher and student in conversation and in contextual submersion. As described in table 4 below, the enactivist learning environment requires teachers to resist the collective patterns of behavior expected of them as directors of learning. This model encourages conversations to start small and then grow to involve the entire room. Under this system, students and teachers begin to imitate each others' desirable traits, behaviors, and actions. Individuals as complex, non-linear, and dynamic systems interact with other systems of individuals and groups, and these interactions extend beyond the classroom to other settings. Teaching higher-level thinking requires the teacher to become the student.[37] The adult learning model used at the U.S. Army War College encourages students to be both student and teacher, and the result is that the vast collective experience and thoughts of the class students and teachers contribute to the learning of the entire group. This model is a good starting point to teach parallel thinking and velocity squared to leaders in the Department of Defense.

	TRADITIONAL LEARNING MODEL	ENACTIVIST LEARNING MODEL
Teacher role	Didactic, one way	Participatory, learner
Student role	Passive	Active
Process	Linear	Non-linear
Behavior	Teacher imposed	Bilateral imitation
Learning and thinking method	Lectures, reading, audiovisual aids, some active participation, tests	Norms, heuristics, hypothesis, metacognition, self-motivation, and reflection

Table 4. Teaching Higher-Level Cognition.[38]

If cognitive models support the adult learning model and similar active learning methods, how easy is it to implement such learning programs? First we must answer several important questions about learning, thinking, intellect, transferability of thinking skills, and creating a culture of higher-level learning. Ron Ritchhart and David Perkins discuss the challenges of teaching higher-level thinking.[39] They posit that the need for teaching thinking has been recognized since at least the time of Plato, that high-end thinking must be taught because it runs counter to our natural tendencies, and that traditional school systems value knowledge accumulation and skill acquisition over reasoning and the higher-level thinking skills such as creative and critical thinking mentioned previously. The authors pointedly identify five challenges in teaching higher-level thinking:

1) Can thinking be taught?
2) What is good thinking?
3) Can we teach the requisite intellectual attitudes and character?
4) Is the thinking transferable to other areas of life and academics?
5) Can we teach the culture of higher-level thinking?

To summarize the conclusions of Ritchhart and Perkins, thinking can be taught, and there are theories of what qualities and skills constitute good thinking. Furthermore, it appears that intellectual attitudes and character, both of which can be exercised to be transferable to other situations, can also be taught. Higher level thinking can be taught through a systematic and accepted model to develop the desirable character and attitudes that may transfer to other areas of life if this learning is accomplished in a pervasive culture. Leaders can be taught through changes in the adult education culture and system. So, we can create a culture that engenders higher-level thinking, and we can create an educational system in which these thinking processes are practiced in many situations and scenarios.

In the preceding sections, I presented parallel thinking, a system of higher-level thinking. I proposed velocity squared as a method to accelerate decision-making so that parallel thinking is practical. Theories of decision-making, cognition, and learning support the idea that good thinking can be taught and that this learning can be transferable to other situations if taught in a comprehensive learning culture that encourages active, participatory higher-level cognition. In the last section of this paper, I propose five simple but evidence-based recommendations to create this culture of education that nurtures and encourages higher-level thinking in the Department of Defense.

The Five Fundamental Changes

This list of recommendations by the author improves the educational system for adult leaders. At the risk of oversimplification for the sake of brevity, I suggest five fundamental changes that will teach our strategic leaders to think using higher-level processes such as parallel thinking and velocity squared:

1) Change the culture of education from linear to non-linear thinking and static to dynamic thinking;
2) Incorporate the new culture and teaching models into our educational systems;
3) Change the culture in the real world of the Department of Defense;
4) Encourage perpetual learning;
5) Give leaders, students, and teachers time to think, read, learn, and apply higher-level thinking skills.

These recommendations list the changes required in the fast-paced, uncertain, complex, and unpredictable world today. Higher-level thinking such as parallel thinking and velocity squared allow leaders to make sound and timely decisions. The way for leaders to learn essential cognitive skills and qualities to succeed in this world is to change our educational and departmental cultures. Leaders can and must learn to develop successful ways to think.[40, 41]

Summary

The Department of Defense needs leaders who think strategically and act decisively at the right time and in the right ways. Five-dimensional *parallel thinking* is a higher-order cognitive skill that can be taught to leaders as a method of decision-making. This method simplifies the complex nature of decision-making and cognition. Parallel-thinking gives leaders the ability to analyze future decisions from multiple perspectives and prepare to respond to the rapid changes predicted by the advent of the information age and globalization.

Leaders will face tremendous challenges of time management as more and more information is available through technology. The concept of *velocity squared*, a means of accomplishing rapid decision-making, increases both the velocity of decision-making and of measurable effects. Velocity-squared is acquiring data quickly, converting it rapidly to usable information, quickly synthesizing information into knowledge, and then acting expeditiously to change and shape the environment to one's advantage. The action measurably creates a new and deliberate direction beneficial to the decision-maker.

The need for leaders who can think strategically extends to the company level as the requirement for rapid tactical decisions sometimes has strategic implications. Decision theory and cognitive theory show that higher-order thinking such as parallel thinking and velocity squared can be taught. Rather than hunting and gathering for leaders who already possess these qualities, the Department of Defense should ranch and farm leaders through career-long education in higher-order thinking and a comprehensive change in the educational and Department of Defense cultures. The potential to create an abiding source of top leaders exists as a process of cultural change throughout the Department of Defense.

Endnotes

[1] Although beyond the scope of this short work, I believe that my literature review shows we must review the purpose of the U.S. educational system and its strategic goals for the future. The U.S. educational system is designed to adequately educate the average or below-average student rather than develop the unique strengths of average and above-average student. There is evidence showing that qualities such as creativity are not directly associated with IQ level. Instead, there is evidence that students manifest strengths and weaknesses in different aspects of intelligence such as those defined in the Multiple Intelligences Theory of Henry Gardner. Our U.S. Department of Education spent $9,596,000 in fiscal year 2006 for gifted student education out of a total special education grant of $10,582,986,540 or 0.09%. After this amount of expenditure, our students continue to fall behind on tests of international school competence. This failure may be a result of our educational habit of using linear teaching methods (discovering) when non-linear methods (mastering and application) have been proven to enhance abilities to develop predictions, explanations, alternatives, and plans.

[2] The validity of string theory and superstring theory are debated among physicists. The intent of the author is not to validate these theories. Instead, the author's thoughts spawned by these concepts are the inspiration for this system of cognition and decision-making.

[3] Alan Boyle, "Physicists Probe the Fifth Dimension," 6 June 2006; available from http://www.msnbc.msn.com/id/13070896/page/2/; Internet; accessed 2 Oct 2006. According to this article, the first approach uses the CERN laboratory Large Hadron Collidor to smash protons fast enough to take it to another dimension. The extra momentum would show up as extra mass. The second method uses a future Laser Interferometer Space Antenna (LISA) to detect gravitational waves that may show evidence for cosmic inflation in other dimensions according to Einstein's theory of relativity. The third method will use the Gamma-Ray Large Area Space Telescope (GLAST) scheduled for launch next year to detect miniature black holes that will bend gamma ray trajectories. According to the author, this experiment has the potential to show that membrane or "brane" theory of parallel universes is a better theory than Einstein's theory.

[4] Elliott Jaques, *The Form of Time* (New York: Crane, Russak & Co., 1982), 97-100. Jaques describes a concept similar to parallel thinking. His theory describes "life-space" using the axes of intention and succession. The axis of succession is the timeline, and the axis of intention is the equivalent of parallel possibilities. These variations are the conscious and

unconscious actions of the psychological states of mind. He proposes that the future exists only in the mind and is created with a specific goal or direction.

[5] Lori Bergen, Tom Grimes, and Deborah Potter, "How Attention Partitions Itself During Simultaneous Message Presentations," *Human Communication Research* 31, no. 3 (July 2005): 311-36. Multitasking and attention partitioning such as is done when we read the scrolling news at the bottom of television news while listening to the audio broadcast must be done with caution. In this study, the researchers found that college student CNN viewers lost as much as ten percent of the audio news information when reading the scrolling news. The multisensory format used by Music Television (MTV) was adopted by CNN in 2001 and increased viewing in the 18-34 year old group by 104% within one year. Further research is required across age groups to determine if the younger Generation X and Generation Y cohorts can process parallel input simultaneously. In contrast, parallel thinking focuses on output and is performed in one parallel course at a time. The concept that multiple stimuli diminishes proper processing, especially when mixed modes such as auditory and visual are encountered may be useful in confusing enemy combatants during an attack.

[6] U.S. Department of the Army, *Army Leadership*, Field Manual 6-22 (Washington, D.C.: U.S. Department of the Army, June 2006 Final Draft), A-3.

[7] Jonas Langer, "The Evolution of Cognitive Development: Ontogeny and Phylogeny: Essay Review of *Origins of Intelligence: The Evolution of Cognitive Development in Monkeys, Apes, and Humans* by S.T. Parker and M.L. McKinney," *Human Development*, no. 47 (2004): 73-76.

[8] Richard E. Nisbett, *The Geography of Thought: How Asians and Westerners Think Differently…and Why* (New York: The Free Press, 2003), xv. The author found through his studies that contrary to his initial beliefs, even short-term training sessions can change both patterns of reasoning and behavior that persisted beyond the experimental setting.

[9] Robert Boostrom, *Thinking: The Foundation of Critical and Creative Learning in the Classroom* (New York: Teachers College Press, 2005), 19-25.

[10] Edgar Gleri, et al, "Operation Anaconda Case Study," 13 November 2003; available from http://www.au.af.mil/au/awc//ns/electives/AirpowerPostGulfWar/Lsn08/ANACONDA%20Case%20Study%20UNClass%20Final.pdf; Internet; accessed 19 January 2007.

[11] Arab officer, U.S. Army War College International Fellow, conversation by author, October 2006. Because of the U.S. Army War College policy of non-attribution of comments to specific individuals in print, the Arab officer remains unnamed.

[12] Nisbett, xix.

[13] Ibid, xvii-xix. Summarized narrative findings by author in table form.

[14] Stephen J. Gerras, "Thinking Critically About Critical Thinking: A Fundamental Guide for Strategic Leaders," *U.S. Army War College Selected Readings Academic Year 2007: Fundamentals of Strategic Thinking*, (Carlisle Barracks, PA, 2007), 33-59.

[15] Ibid, 14-19.

[16] James R. Downey, Professor, U.S. Army War College, project advisor, conversation with author, 8 February 2007. Dr. Downey described his thesis finding that earlier launch did not result in faster satellite destruction. When the assumption that immediate launch would lead to faster destruction was eliminated, launch time became a variable. The new calculations led to faster destruction times.

[17] Arnoud DeMeyer, Christoph H. Lock, and Michael T. Pich, "Managing Project Uncertainty: From Variation to Chaos," *MIT Sloan Management Review* 43, no. 2 (Winter 2002): 63.

[18] I would like to acknowledge Dr. James Downey, faculty advisor for this SRP, for introducing me to the concept of chaos theory and futuring as well as refining my thinking on plausible future scenarios. I am also indebted to Dr. Downey for his tremendously helpful review of this paper.

[19] Massimo Pigliucci, "Chaos and Complexity," *Skeptic*, no. 3 (2000): 64.

[20] Craig Piers, "The Mind's Multiplicity and Continuity," *Psychoanalytic Dialogue*s, no. 2 (2005): 230-231.

[21] Diane F. Halpern, *Thought Knowledge: An Introduction to Critical Thinking* (Malwah, NJ: Lawrence Erlbaum Associates, Inc., 1996), 407-9.

[22] Ibid, 407.

[23] U.S. War College International Fellow, small group discussion, December 2006. Because of the U.S. Army War College policy of non-attribution of comments to specific individuals in print, the officer remains unnamed. The facts, assumptions, and consequences of the Israeli-Lebanese conflict were discussed.

[24] Joel Garreau, *Radical Evolution: The Promise and Peril of Enhancing Our Minds, Our Bodies—and What It Means to be Human* (New York: Broadway Books, 2005), 45-77. Garreau describes "Moore's Law" which states that the complexity of transistor chips would double every eighteen months. This doubling is called an exponential increase. Although some including Garreau would argue that such exponential increases eventually decrease in velocity, there are few who would argue that information and technology are expanding at a phenomenal rate.

[25] D. Robert Worley, *Shaping U.S. Military Forces: Revolution or Relevance after the Cold War* (Arlington, Virginia: D. Robert Worley, 2005), 336. In his chapter on transformation assessment, Worley argues that the current military planning method of two year cycles is a result of the Cold War mentality. He suggests that a change from deliberate to crisis action planning would show that the Army is truly transforming from a major-wars force to a small-wars force.

[26] Rauno Kuusisto and Tuija Helokunnas, "*Time in information operations*," 20-21 November 2003; available from http://lib.tkk.fi/Diss/2004/isbn9512274639/article4.pdf; Internet; accessed 15 December 2006.

[27] Tommy Franks, *American Soldier* (New York: Regan Books, Harper-Collins Publishers Inc., 2004), 350.

[28] Ibid, 368.

[29] Dennis M. Murphy and Jeffrey L. Groh, "Landpower and Network-Centric Operations: How Information in Today's Battlespace Can Be Exploited," *NECWORKS*, no. 1 (2006): n.p.

[30] Richard D. Hooker, H.R. McMaster, and Dave Gray, "Getting Transformation Right," *Joint Force Quarterly* 38: 20-27.

[31] Robert Garigue, "Technical Forward," in *Information Operations: All Information, All Languages, All the Time; The New Semantics of War & Peace, Wealth and Democracy* (Oakton, VA: OSS International Press, 2006), 9.

[32] Combined Arm Doctrine Directorate, *The Army in Theater Operations*, Field Manual 3-93 DRAG Edition, (Fort Leavenworth, KS: Combined Arms Directorate, 2 February 2005), 6-55.

[33] *Wayne Lee,* Decision Theory and Human Behavior (New York: John Wiley & Sons, Inc., 1971), 1-354. *Rational decision theory* assumes that individuals make decision based on reason and a rational system of thought such as knowledge, religion, or ethics. *Mathematical decision theory* relies on a formal system of rules for various situations. *Probability decision theory* is based on objective mathematical probability and subjective belief probability. *Utility decision theory* assumes that individuals make choices based on the value or usefulness of consequences. *Gambling behavior theory* attempts to explain decisions when individuals know that the odds are rationally against winning and when ambiguity and uncertainty are factors. *Probability learning theory* describes individual predictions about random events. Probabilistic categorization studies the basis for categorization used by individuals for predictive power.[33] *Information and dynamic decision theory* describes the gathering of information, the value of information, and the extent of information and their effect on decision-making. *Game theory* analyzes decision-making when there is an opponent or opponents and the types of conditions and objectives in decision-making. Newer research in the field of decision-making addresses the influence of emotion and loss of rationality caused by brain damage in individuals and animals.

[34] Robyn A. LeBoeuf and Eldar B. Shafir, "Decision Making," in *The Cambridge Handbook of Thinking and Reasoning*, eds. Keith J. Holyoak and Robert G. Morrison (Cambridge: Cambridge University Press, 2005), 243-265. The authors categorize choices as *certain* when outcomes are known and definite such as with a restaurant menu; *uncertain* and *risky* when the outcome probabilities are known such as with gambling or insurance; and *ambiguous* when the outcomes are known and the probabilities are not known and must be guessed.

In choices under *uncertainty*, studies show that risk aversive behavior predominates when prospective gain is small and risk seeking behavior predominates when prospective gain is great. Further studies show that the *framing* of certainty and risk may reverse these behaviors. By including certainty in an uncertain choice, people prefer this modified choice even if the overall prospect for gain of the original choice is the same. The authors suggest emphasizing certainty to improve a beneficial outcome in negotiations.

The authors also describe choices involving *certainty*. Individuals value more an object in their possession and feel greater pain in losing it than they would feel pleasure in obtaining the object. Loss aversion thus makes people seek stability and loss aversion choices. Additionally, framing of choices in a positive description makes the positive choice more desirable. For

example, people prefer the choice of a surgery with a 30% chance of a cure over a surgery with a 70% chance of non-cure. As another example, the description of a difference between 100% and 97% seems much smaller than the difference between 0% and 3%. In other words, people would prefer a choice with a 97% chance of success rather than a choice with a 3% chance of failure. Loss aversion, positive framing, and relative magnitude of differences all affect individual choices.

LeBoeuf and Shafir discuss four major factors in which inconsistencies arise.[34] First, *conflict* affects choices by people. In difficult decisions, people look for a compelling rationale for their decision to justify a choice; otherwise, people tend to avoid or postpone such choices, choose the option that minimizes conflict, or choose the status quo. When offered a third choice between two choices but similar to one of the initial choices, people will tend to choose the similar but obviously better choice, a phenomenon called asymmetric dominance. When people are offered a third choice that is extreme and makes one of the initial choices seem to be intermediate and reasonable, people will tend to choose the intermediate option in an effect called the compromise effect.

Second, decisions are also affected when people are asked to explain the *reason* for their decisions. In this situation, people rely more heavily and weight decisions toward factors based on temporary and fleeting thought processes rather than objective criteria. Choices based on reason also produce inconsistencies in choices when the certainty of the reason for the choice changes. Also, people who delay decisions to await more information can be heavily influenced by that additional information compared to having had the information in the first place. In short, the use of reason in choice can create inconsistencies in decision-making.

Third, comparing choices with multiple factors requires complex weighting of attributions. The authors state that in this scenario, choices made are unreliable. Linear, objective comparisons are most effective in this case. For instance, people would rather choose a high payoff choice with a lower chance of winning, but they would pay more for a lower payoff choice with a higher chance of winning. Also, people tend to weight strengths more heavily when selecting an option, and they tend to weight weaknesses more heavily when rejecting an option. Clearly-known attributes carry greater weight in decisions than vaguely-know attributes. Choices when offered side-by-side rather than in isolation are easier to make and can affect the selection. People consider life experiences to mentally compare options and potential consequences, but a personal experience that carried significant consequences in isolation may affect a person's choice of weighting the theoretical and real-life consequences. "Never again" decisions and risk-averse decisions arise from this type of phenomenon.

The fourth and final factor that may affect choice as described by LeBoeuf and Shafir is that of *local versus global perspectives*. People tend to consider repetitive decisions such as diet in isolation rather than with consideration of the long-term cumulative effect. For instance, physicians choose to treat and order laboratory studies more frequently when evaluating a single local patient versus globally recommending fewer laboratory studies, more conservative measures, and slower sequential evaluation and treatment for the general population. As a result of individualization of serial choices, people choose more aggressive options and discount factors affecting long-term outcome. Also, people include unimportant details into their decision-making rationale such as whether they would drive 20 minutes to save $5 on a $15 item versus a $125 item.[34] Temporal discounting is the phenomenon in which people will choose an option that provides immediate gratification or avoids immediate adverse effects when they would not choose the same option for long-term benefit or harm. Frame of mind may

influence decisions. When primed beforehand with certain words describing characteristics, people will tend to place more emphasis on advertisements which stress these characteristics. Identity context affects decisions, and people choose priorities differently when given the choice in the context of being a parent or a worker. Emotions also affect choice. The weight of a loss is perceived to be greater in people in a positive mood than in people in a negative mood. People in a good mood are risk averse, seeking to preserve that mood. People experiencing anger are more risk seeking, and people feeling fear are more risk averse. These transient personal physical or mental states may affect choice, and the choice may change once the temporary condition changes. This phenomenon may help to explain how feelings and emotions experienced by soldiers in Iraq or jail guards in the Abu Ghraib Detention Facility may lead to uncharacteristic or illegal behavioral choices, even if these emotions are caused by unrelated incidents.

[35] R.J. Gallistel and Rochel Gelman, "Mathematical Cognition," in *The Cambridge Handbook of Thinking and Reasoning*, eds. Keith J. Holyoak and Robert G. Morrison (Cambridge: Cambridge University Press, 2005), 559-588.

[36] Timothy A. Salthouse, "Effects of Aging on Reasoning," in *The Cambridge Handbook of Thinking and Reasoning*, eds. Keith J. Holyoak and Robert G. Morrison (Cambridge: Cambridge University Press, 2005), 589-605. Decision-making and the factors, both human and situational, which affect choices and decisions, have been well-studied. If choices may be categorized, and if decisions may be influenced by human personality and environmental scenarios, the question arises whether leaders may learn how to perceive their objective environment, temper their outward view with insight of their personality traits, and apply judgment and experience to a particular situation to make good decisions.

[37] Brent Davis and Dennis J. Sumara, "Cognition, Complexity, and Teacher Education," *Harvard Educational Review*, vol. 67 (Spring 1997): 105-125. The *representationist model* that likens the brain to a machine or a computer and the preferable *constructivist model* that is more biology than physics by incorporating a non-linear dynamic process are both still inadequate.

[38] Table created based on information synthesized from authors cited in this section.

[39] Ron Ritchhart and David N. Perkins, "Learning to Think: The Challenges of Teaching Thinking," in *The Cambridge Handbook of Thinking and Reasoning*, eds. Keith J. Holyoak and Robert G. Morrison (Cambridge: Cambridge University Press, 2005), 775-802. Many experiments have shown modest but significant improvement in *magnitude, persistence, and transfer* of learning in young and teenage children. Teaching *good thinking* in many teaching approaches include norms, heuristics, hypothesis, metacognition, self-motivation, and reflection and are active learning methods. Even with appropriate approaches, multiple methods of teaching must be used to optimize the multiple intelligences and mitigate intellectual weaknesses of individual learners and teachers. Developmental psychological theories question whether *personality* traits can be changed, but several experiments have shown promise in altering behavioral habits and disposition through an environment that maximizes those positive qualities and talents that are already present in learners. *Transfer*, ambition, spirit, rapid decision-making, and higher-level thinking are specific to the thinking task and context. In other words, just as in a sports skill, the specific sport must be practiced in the proper setting, but there is some evidence for cross-training benefit if the learner is able to abstract his thinking principles. Practically speaking then, a learner must not only perform repetitive drills, but the learner must apply this learning in new and dynamic settings such as a

game for an athlete. Finally, the higher-level thinking *culture* must be an immersion in all areas of learning. Although there may be some benefit to compartmentalized high-level thinking, the true potential of leaders or children to develop acute higher-level thinking character is best developed in an all-encompassing culture.

[40] Philip N. Johnson-Laird, "How the Mind Thinks," in *Conceptions of the Mind: Essays in Honor of George A. Miller*, ed. Gilbert Harman (Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., 1993), 173-215. The author describes the thinking process as "the organization and functioning of mental representations and processes." He concludes that "thinking is a computational process that leads from one mental representation to another."

[41] Robin M. Hogarth, *Judgement and Choice: The Psychology of Decision*, 2nd ed. (Chichester, Great Britain: John Wiley & Sons, Ltd., 1987), 133. The author describes memory as "a process of active reconstruction rather than passive recall…" As a result, memory is imperfect and is affected by many internal and external factors.